

CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus for levitating a diamagnetic material, said magnet comprising:
a first superconducting coil having a central axis, said first coil producing a magnetic field when energized with current;
a second superconducting coil positioned concentrically within the first coil, said second coil having a central axis generally parallel to the central axis of the first coil and producing a magnetic field when energized with current; and
a third superconducting coil positioned concentrically within the second coil, said third coil having a central axis generally parallel to the central axes of the first and second coils and producing a magnetic field when energized with current and said third coil defining a bore of the magnet, said magnetic fields of the first, second and third coils combining to produce an operational magnetic field for levitating the diamagnetic material inside said bore.
2. The apparatus of claim 1 wherein the first superconducting coil comprises NbTi superconducting wire.
3. The apparatus of claim 1 wherein the second superconducting coil comprises Nb₃Sn superconducting wire.
4. The apparatus of claim 1 wherein the third superconducting coil comprises Nb₃Sn superconducting wire.
5. The apparatus of claim 1 wherein the first superconducting coil has an inner diameter of about 104 millimeters.

6. The apparatus of claim 1 wherein the second superconducting coil has an inner diameter of about 70 millimeters.
7. The apparatus of claim 1 wherein the third superconducting coil has an inner diameter of about 30 millimeters.
8. The apparatus of claim 1 wherein the first superconducting coil has an outer diameter of about 240 millimeters.
9. The apparatus of claim 1 wherein the second superconducting coil has an outer diameter of about 104 millimeters.
10. The apparatus of claim 1 wherein the third superconducting coil has an outer diameter of about 70 millimeters.
11. The apparatus of claim 1 wherein the second superconducting coil has an outer diameter less than an inner diameter of the first superconducting coil.
12. The apparatus of claim 1 wherein the third superconducting coil has an outer diameter less than an inner diameter of the second superconducting coil.
13. The apparatus of claim 1 wherein the first, second, and the third superconducting coils are each energized by applying a current of about $0.500\text{E}+03$ amperes to each coil.
14. The apparatus of claim 1 wherein the maximum operational magnetic field is at least about 11.7 T.

15. The apparatus of claim 1 wherein the operational magnetic field produces a levitation point for levitating the diamagnetic material inside said bore and about 15 mm above a field center of the magnet, said field center corresponding to an intersection between the central axis and a mid-plane of the first, second, and third coils.

16. The apparatus of claim 15 wherein the operational magnetic field produces a levitation point for levitating the diamagnetic material inside said bore and between about 0 mm and about 30 mm above the field center of the magnet.

17. The apparatus of claim 15 wherein the operational magnetic field levitates a mass of diamagnetic material having a diameter of about 2 millimeters.

18. A method for producing a magnetic field for levitating a diamagnetic material, said method comprising the steps of:

positioning a first superconducting coil having a central axis concentrically around a second superconducting coil having a central axis generally parallel to the central axis of the first coil, said first and second coils each producing a magnetic field when energized with current;

positioning a third superconducting coil concentrically within the second coil, said third coil having a central axis generally parallel to the central axes of the first and second coils and said third coil defining a bore and producing a magnetic field when energized with current;

applying currents to the first, second and third coils to produce magnetic fields, said magnetic fields of the first, second and third coils combining to produce an operational magnetic field within the bore for levitating the diamagnetic material in the bore; and

positioning the diamagnetic material within the bore to levitate the diamagnetic material in the bore.

19. The method of claim 18 wherein the concentrically positioned first, second and third coils are housed in a cryostat, and wherein said cryostat controls the temperature of the first second, and third coils.

20. The method according to claim 18 wherein the diamagnetic material is levitated in the bore and 15 mm above a field center of the magnet, said field center corresponding to an intersection between the central axis and a mid-plane of the first, second, and third coils.

21. The method according to claim 18 wherein the diamagnetic material is levitated in the bore and between about 0 mm and about 30 mm above the field center of the magnet.

22. A superconducting magnet for levitating a diamagnetic material, said magnet comprising:
a first superconducting coil having a central axis, said first coil producing a magnetic field when energized with current;

a second superconducting coil positioned concentrically within the first coil, said second coil having a central axis generally parallel to the central axis of the first coil and producing a magnetic field when energized with current;

a third superconducting coil positioned concentrically within the second coil, said third coil having a central axis generally parallel to the central axes of the first and second coils and producing a magnetic field when energized with current and said third coil defining a bore of the magnet, said magnetic fields of the first, second and third coils combining to produce an operational magnetic field for levitating the diamagnetic material inside said bore;

a cryostat for housing the concentrically positioned first, second, and third coils, and for controlling the temperature of the first second, and third coils.